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Security Information

SM-38: SOVIET BLOC CAPABILITIES AND PROBABLE COURSES OF ACTION IN
ELECTROMAGNETIC WARFARE

Appendix B: Evaluation of Technical Factors

1. BLOC ELECTROMAGNETIC WARFARE ACTIVITIES TO DATE

A. Extent and Techniques of Broadcast Jamming

1. Short wave jamming was first directed against Russian-language VOA and BBC programs on 3 February 1948, and continued on a moderate scale during the next year. On 24 April 1949 jamming action was greatly stepped up.* Frequency ranges were extended to include medium and long wave broadcasts, the number of jammers employed was increased, and jamming was extended geographically through the coverage of Satellite and Finnish languages. Sources of programs jammed included Radio Free Europe, Radio Free Asia, and Vatican City. In 1953 Hebrew and Turkish language programs have also been jammed.

2. In general, the jamming has been directed against programs intended for reception within the Bloc area. However, on 30 January 1953 a Danish long wave broadcasting station was jammed while carrying a domestic program in Danish which the Soviet Minister had stated was insulting.

*OSI-1-50 "Historical Developments in the Jamming of the VOA by the USSR", CIA, 20 January 1950

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3. Broadcast signals ranging in frequency from 230 kc. to 21.7 mc. have been reported jammed. The jamming signal is usually a relatively narrow band so that it will not be likely to affect neighboring channels. The jammers in use at the present time have very wide variations in power output, depending upon the frequency of operation and the type of coverage intended. Output ranges from a possible low of 1 kw. to highs of 50 to 200 kw. on high frequencies and to 500 kw. on medium or low frequencies.

4. We estimate that the number of transmitters employed for jamming is approximately 900. The majority of the jamming stations are in the European USSR; a relatively small number are in the Satellites. The USSR has at various times diverted transmitters from domestic program service to jamming, and has jammed even when *the jamming* it covered domestic programs. Cooperation between the USSR and Satellites, and between Satellites, is indicated by use of jammers in one Bloc country to cover programs directed to another.

5. Control of 30% to 40% of the jammers is immediate and flexible so that they can follow changes in schedule or frequency, often within a minute or less. This reveals existence of an efficient monitor/control network. Control of the remaining jammers is apparently less direct since they do not quickly respond to changes -- sometimes not for several days. The organization

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responsible for the control of the jamming of VOA has not been positively determined. However, responsibility for basic policy probably is assigned to the MGB (Ministry of State Security).

6. In addition to preventing Western broadcasts from reaching Soviet and Satellite peoples, the Bloc's jamming effort has provided training in jamming techniques and system coordination.

B. Effectiveness of Broadcast Jamming

7. According to an analysis of 2258 monitoring reports from U.S. embassies during 1952, propaganda program transmissions directed to the European Satellites are penetrating the target areas and can be heard with good or better reception on at least one channel for over half the program periods. Programs to the Far East can be heard with good or better reception on at least one high frequency channel for nearly all program periods, but medium frequency is received well only about half the time. Some of this difficulty may be due to interference other than deliberate jamming. On the other hand, these programs have only sporadic penetration within Western USSR, especially in the large urban areas. Technical expedients, such as greatly increasing the number of frequencies used simultaneously to carry the same programs, have apparently not been very successful in the European USSR.

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8. Reports from listeners within the Bloc are limited to non-technical information on effectiveness. Some reports from the Satellites provide technical information on transmitters which could be used for jamming, on development activities, and on tubes and transmitters; these reports shed some light on capabilities. Most of the technical details concerning the present jamming effort have been obtained from careful and repeated observations at receiving stations in friendly territory. Particularly excellent results have come from a restricted but continuous effort by experienced observers

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C. Jamming of Signals Other Than Broadcast

9. In the past three years there have been more than 40 cases of interference with US communication circuits which might have been instances of Soviet jamming. A review of these cases indicates that it is exceedingly difficult to distinguish among: (a) unintentional interference, (b) radio jamming against VOA and BBC which spills over into U.S. communications circuits, and (c) deliberate radio jamming of communications circuits. Incidents of this last type have generally involved air-ground frequencies.

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10. The various incidents reported thus far do not appear to indicate an over-all Soviet plan for interference with US communications circuits. All reported and investigated cases of interference with navigation aids seem to have been unintentional interference from transmitters operating on assigned frequencies. After due allowance for VOA radio jamming and the unintentional interference, however, there still remain a few instances which cannot be readily explained except as deliberate jamming of communications circuits. For example, successful jamming of long range shore-to-ship communications by a jammer apparently located in the vicinity of Leipzig occurred during

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The shipborne receiver was within the effective range of the jammer, a condition which could exist a large portion of the time in the course of naval operations in general war with the Bloc.

11. The lack of conclusive evidence of intentional jamming of military circuits does not indicate a lack of capabilities. The techniques used for broadcast jamming could be used against long range military circuits. It should be noted that for jamming purposes broadcasts to the Bloc offer ~~one~~^S great advantage_A that commercial and military circuits often do not, namely, relatively fixed schedules and channels and proximity of the receiving end. Nevertheless, the Bloc is capable of seriously disrupting long range trans-Atlantic and trans-Pacific circuits. It is believed, however,

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that it is not likely to employ coordinated measures against military communications circuits unless a general war occurs.*

II. PRESENT BLOC CAPABILITIES FOR ELECTROMAGNETIC WARFARE

A. Available Jamming System Components

12. Large scale jamming operations require: (a) transmitters and associated antennas, (b) monitor/control networks, and (c) competent personnel. The Bloc today possesses these necessary elements of a large-scale jamming system.

13. Transmitters and associated antennas. In order to evaluate properly the Bloc jamming transmitter capability, it must be recognized that any radio transmitter can be used to jam certain targets. However, transmitters to be utilized for jamming long range circuits must be capable of operating in the frequency range over which the jamming is to take place. They should be situated geographically to take advantage of varying radio propagation conditions, they should have a reasonably high power output, and they should be designed to make fairly rapid frequency changes. Large numbers of directional

* The technical problem of jamming long range communications has been considered with respect to U. S. transoceanic circuits. It is considered that they are illustrative of the problem of long range communications of other western countries. Time has not permitted an investigation of the special technical problems of jamming of Arctic communications. Consideration has been given to the problems of jamming long range navigation systems used by other NATO countries as well as those used by the U.S.

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antennas capable of beaming transmissions to the target areas should be associated with the transmitting stations.

14. Since the Bloc has shown ability and willingness to divert transmitters from other services, the entire Bloc transmitter plant should be considered as a potential source of jamming equipment. It is estimated that there are at least 9600 significant radio transmitters in the Bloc. Available information on broadcast transmitters operating in the Bloc indicates a total of 421, of which 167 are in the USSR. In the Moscow area there are approximately 38 broadcast transmitters, 25 of which have been active internationally. Since the Bloc began intensive jamming operations, there has been an increasing number of jammers capable of rapid frequency changes. Some jammers make changes of 10-15 kc. in as little as a few seconds, while others require up to a minute. Many radio transmitters now in other services probably could be diverted to a jamming operation with no effect on essential traffic handling capability; additional numbers of transmitters could be diverted through some sacrifice of least essential services.

15. Interception of experimental Loran type signals operating on 150 kc. shows Bloc has high-powered transmitters on LF. Bloc transmissions have been observed on frequencies as low as 20.1 kc/s. International radio frequency registration shows some 26 assignments below 60 kc/s. The indicated power is generally comparatively low,

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although there are two assignments of 120 kw. and one of 100 kw. It is apparent that the special techniques of LF and VLF are well known to the Bloc.

16. The Soviets have been active in the field of antenna design for many years. Observation of some of the main communication centers in the Bloc reveals vast antenna farms of directional antennas permitting efficient transmission in many directions. The Bloc probably has satisfactory antenna arrays associated with many of its transmitters enabling direction of jamming signals toward their target areas.

17. Monitor and Control Networks. An effective monitor/control network must be an integrated part of the jamming system to achieve maximum efficiency in attacks and to nullify evasive action. This network searches out target transmissions, assigns missions to the jammers, and checks results. Study of jammer operations indicates existence of a highly efficient Bloc monitor/control net which probably utilizes wire line communications. One center of such control is believed to be located at Beelitz in East Germany. It is likely that the Bloc could increase these facilities as needed.

18. Competent Personnel. A cadre of personnel skilled in electromagnetic warfare obviously has been developed since concerted jamming commenced in 1949. There have never been any indications

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of general shortages of qualified communications personnel in the USSR. The Soviets are sufficiently knowledgeable and skilled in the field of radio wave propagation to deal with the jamming problem. They have had access to information on most of the work done in the field in the U.S. and elsewhere, and have conducted an extensive research program of their own.

U. Capability for Disruption of Long-range Telecommunications Circuits and Navigation Aids

19. The attached map shows some of our important high frequency transoceanic circuits, and indicates ^{the proximity of many of them} how close the termini of many of them come to Bloc territory. The signals of several circuits traverse Soviet territory in following a great-circle path. A

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consideration was given to summer and winter conditions of propagation. Results showed that conditions are favorable to jamming of all six circuits during a large portion of the time.

20. The receiver at the U.S. end of the circuit is particularly vulnerable because of the proximity of Bloc territory to the transmitter at the far end, making wave propagation conditions very similar over the paths of both the desired signal and the jamming

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signal. With jammers strategically located within Bloc territory, it is concluded that a jamming signal can be established at this end at almost any time. In most cases, the direction of arrival of the jamming signal and the desired signal would be so nearly the same that the use of directional receiving antennas would be little or no help in discriminating between them.

21. The receiver at the end of circuits nearest Bloc territory is in general about as vulnerable as the one at the U.S. end during the summer months. During the winter months freedom from jamming could exist for a period of about four hours or less by a careful selection of operating frequencies. In some cases, directional receiving antennas would be of considerable assistance, but not where the communications path traverses Bloc territory.

22. An operational test of the vulnerability of military communications was made against both ends of the Army's Washington-Heidelberg circuit on 24-25 February 1951. The jamming attempts were made at pre-selected dates, hours, and frequencies based upon results expected from predicted conditions. Heidelberg was jammed on 10 mc/s., but not on 16 mc/s., by a 1.1 kw. transmitter at Athens; Washington was jammed on 16 mc/s. by a 10 kw. transmitter in Berlin.

23. These considerations of jamming point-to-point communications can be applied to mobile communications (shore-to-ship and ground-to-air),

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noting that vulnerability may be higher because the mobile station usually employs relatively low power and does not employ directional antennas. Moreover, there are generally no alternative means of communication for such purposes.

24. Communication with submerged submarines largely depends on very-low frequencies (VLF), chiefly because of their greater under-water penetration. Jamming of these very-low frequencies would seriously impair long-range communications with U.S. submarines. Coverage by existing VLF stations is not presently adequate for world-wide reception even on the surface and in the absence of jamming. As present day receiving antennas are little better than omnidirectional, these frequencies are very vulnerable to jamming; this situation probably will not be improved within the next two years.

25. Recent Soviet experiments on their LF Loran chain operating on 150 kc. showed substantial capability for jamming in the field of low frequency high power transmission. Practical experience gained by the Soviets in experimenting with their own long-range navigation aid system would be of value to them should they attempt to jam western systems of a similar nature. Propagation characteristics would grant our N.E. Atlantic Loran chains a high degree of immunity during daylight hours, but no such immunity could be expected when

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the path of the jamming transmission lies wholly or for the major part in darkness. However, alternate navigation aids operating in the frequency band under 30,0 mc. -- the Decca navigator, low/medium frequency beacons, and Consol -- are available in the European theater. All three systems operate on low frequencies and use some form of continuous wave transmissions; they are vulnerable to "spoofing" and, to a lesser degree, to jamming.

26. The effectiveness of a jamming signal will vary according to the type of service against which it is operating. The over-all problem involves a complex combination of types of communications and jamming signals. Skillful employment of a diversity of communications channels having differing vulnerabilities to each type of jamming can increase the amount of penetration attained, but no conventional system is invulnerable. Nevertheless, there is one type of communications of limited utility which is relatively difficult to jam; namely, the "Squirt" system whereby short messages are transmitted at very high speed on pre-arranged frequencies. The short time the signal is on the air makes it difficult to locate it and set the jammers.

III. POTENTIAL FOR INCREASING PRESENT CAPABILITIES

A. Capability for Diversion of Existing Facilities

27. The technical problem of diverting equipment and personnel

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from other services to jamming, at least in the high frequency bands, is probably not difficult because (a) the basic techniques are well worked out in the existing system, and (b) there is no apparent lack of facilities available for diversion. Diversion of broadcast transmitters, regularly done during periods of maximum jamming effort, would imply that the control system presently used for jamming has connections already established not only with stations which are set up exclusively for jamming, but also with other radio communications centers. Many of the estimated 900 jammers now employed may be located at such communications centers -- there is definite evidence of this in several cases.

28. Diversion of high powered VLF and LF equipment is not as easy as the diversion of HF equipment because of technical and operational problems such as greater difficulty in making frequency changes. This diversion nevertheless is within present Bloc capabilities.

B. Potential for Increased Facilities

29. The scientific and developmental potential of the Bloc in electronics is large and could support greater jamming activity. There are indications of current laboratory developments in the jamming field. The Bloc has developed and constructed a substantial number of high-power transmitters, and has done considerable research

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in this field. High-powered (20 to 500 kw.) LF and HF transmitters have been developed in East Germany, Hungary, and Czechoslovakia for broadcast and other uses. The development of a number of high-power tubes by the USSR, Hungary and Germany will also contribute to the Soviet potential for the design of high-power jamming transmitters. Little is known about specific developments which would contribute to Bloc potential in VLF communications during the next two years.

30. Other factors which may indirectly contribute to Bloc jamming capacity are the normal expansion of wire line and multi-channel carrier telephone facilities, as well as the expanding use of decimeter and microwave links to supplement these and existing point-to-point radio facilities. A considerable effort is being made to develop and produce large numbers of these items for civil and military use. This could release existing radio facilities for other purposes such as jamming of long range communication circuits.

IV. BLOC VULNERABILITY TO JAMMING

31. Both microwave and wire communication facilities are practically immune to jamming. The Bloc has extensive wire line and probably some microwave facilities in the European area. In Asia, coverage by these alternate means is nearly non-existent. Expansion of alternate means probably will continue, further reducing the vulnerability of Bloc communications to radio jamming.

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32. The Bloc can greatly minimize the effect of its jamming on its own communication circuits by judicious selection of transmitter locations, by use of suitable directional antennas, by use of alternate means of communication, and by advance planning. It is unlikely that interference could be avoided entirely. Due to the heavy use of the 3500-6000 kc. band by Bloc services (see attached chart), jamming in this frequency range would undoubtedly cause some trouble to their own services.

33. The Bloc fosters, controls, and trains a large number of amateur radio operators. Many of them have developed a high degree of skill in the reception of voice and telegraphy due to the heavy interference which exists on the amateur bands. This amateur skill may contribute to Bloc capability to mitigate its own and western jamming of voice and radio telegraph circuits.

34. The basic technical considerations in jamming Bloc communications are: (a) propagation conditions, (b) performance characteristics of equipment, and (c) ability to operate jammers in strategic locations. In cases where jammers could be positioned near one end of a Bloc circuit on the great circle extension of the circuit, the receiver at the other end would be highly susceptible to jamming. Receiver antenna directivity would offer no protection in such cases because of the similar directions of desired and jamming signals. In other cases, the conditions for jamming would vary greatly with

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each circuit considered and the times of operation.

V. EFFECT OF GENERAL WAR ON THE FOREGOING CONSIDERATIONS

35. The technical capabilities existing during the cold war would obtain in general war conditions. It is believed that general war would be launched with jamming of long range communications circuits as part of the initial surprise, and that there would be little or no communications jamming in advance. This would include VLF communications to submarines. In addition, spoofing and jamming of navigation aids probably would be common.

36. Although the Bloc might not find it necessary to do so, confiscation of some or all broadcast receivers would release the broadcast system for jamming military targets. In that event it would be necessary to place major reliance for mass communications to the Bloc public upon the extensive wire diffusion network. Restrictions on Bloc non-essential communications traffic would release additional transmitters for jamming purposes. However, the probable change in the total volume of essential Bloc traffic under general war conditions cannot be estimated.

37. Depending on the cold war political and military situation, there may be a change in the availability to the West of sites at strategic locations for retaliatory jamming. In the event of general war, direct military action might destroy significant quantities of the jamming transmitters.

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VI. INDICATIONS OF PRECLUSIVE USE POLICY

38. The Bloc has registered a large number of frequency assignments with the International Telecommunications Union. It has been generally held that the number exceeds its requirements. If so, it could be for the purpose of providing a stockpile of frequencies either with or without a precise plan for arbitrarily controlling the spectrum to preclude use by other nations. There is some evidence that the Bloc has made moderate use of frequencies to demonstrate those frequencies are required. However, this tactic has been employed by practically every nation and would appear to have no unusual significance.

SEE 8 APRIL DRAFT FOR FOLLOWING ATTACHMENTS:

- I -- Soviet and Satellite transmitting facilities.
- II -- Map showing US Government and commercial radio circuits, and USSR major radio communication centers.

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO :

DATE:

FROM :

1) Reconcile conflicting use of singular and plural in phrase,

SUBJECT: "Communications circuits" — the plural is more common.

(see paragraphs: 9, ~~10~~, 30, 32 $\frac{3}{4}$ for exceptions)

2) The unedited draft used "monitor control", "monitor-control", and "monitor/control" — the last most extensively. Instances of use without slash appear in paragraphs: 5, 17, 12.

3) And, of course, there's the problem of KC or kc, KC or kc/s, etc., etc.

4) Use of hyphen in "high-power" seemed standard, so I marked ¶ 15 for change.